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PRELIMINARY STUDY AND SITE SELECTION FOR BLAST CASTING AT FORDING RIVER MINE

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October, 1986

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23pp

ENERGY RESEARCH PROGRAM
COAL RESEARCH LABORATORIES
DIVISIONAL REPORT ERP/CRL 86-120(TR)

MICROMEDIA

PRELIMINARY STUDY AND SITE SELECTION FOR BLAST CASTING AT FORDING RIVER MINE

by

H. G. Naidu*

ABSTRACT

Surface coal mining in the mountainous regions of Western Canada is faced with numerous problems. These adversely affect the mine productivity thereby making it more difficult to remain competitive in the export market. Therefore, any economic improvement through modern techniques is vital to the Canadian coal industry. Blast Casting is an innovative technique with good potential for improving mine site economics. This technique is utilized in several other countries with encouraging results. The Advanced Mining Technology Group of the Coal Research Laboratories, CANMET has conducted a literature search on the technique and assessed its applicability in Western Canadian surface mines. With this objective a co-operative research program with Fording Coal Ltd. has been initiated at their mine in B.C. The initial study and site selection process has been discussed in this report.

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ÉTUDE PRÉLIMINAIRE ET CHOIX DE L'EMPLACEMENT POUR L'ABATTAGE À L'EXPLOSIF À LA MINE DE FORDING RIVER

par

H.G. Naidu*

RÉSUMÉ

L'industrie de l'exploitation minière en surface du charbon dans les régions montagneuses de l'Ouest canadien fait face à de nombreux problèmes. Ces derniers ont entre autres un effet sur la productivité minière et rendent plus difficile le maintien d'une place concurrentielle sur les marchés d'exportation. Par conséquent, toute amélioration sur le plan économique, grâce aux méthodes d'exploitation de pointe, est vitale à l'industrie charbonnière au Canada. La méthode d'exploitation par abattage à l'explosif est une technique nouvelle qui offre de nombreuses possibilités dans le but d'améliorer la rentabilité d'une exploitation minière. Cette méthode est très répandue dans plusieurs pays actuellement, et donne des résultats encourageants. Le Groupe de la technologie minière de pointe des Laboratoires de recherche sur le charbon du CANMET a effectué une étude documentaire sur la présente méthode et évalué son applicabilité pour l'exploitation des mines à ciel ouvert de l'Ouest canadien. En tenant compte de ces objectifs, on a donc créé un programme de recherche en collaboration avec la Fording Coal Ltd. qui sera réalisé dans leur mine en Colombie-Britannique. L'étude préliminaire et le choix de l'emplacement sont aussi décrits dans le présent rapport.

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CONTENTS

	Page
ABSTRACT	i
RESUME	iii
CONTENTS	v
INTRODUCTION	1
GEOLOGY	3
MINE LAYOUT AND MINING PRACTICE	3
PRELIMINARY STUDY	5
SITE SELECTION	7
Applicability	7
Selection Criteria	8
Site Evaluation	9
Eagle stage-IV	9
Browny pit	9
Lake pit, Greenhills	11
3-pit, Greenhills	14
I-pit, Greenhills	14
Old stage-4 Eagle	14
CONCLUSIONS	18
REFERENCES	18

FIGURES

Fig.1	Location map of Fording River Operations	2
Fig.2	Typical structure cross section	4
Fig.3	Mine plans showing pits and sites for casting	6
Fig.4	Site for mountain top casting	10
Fig.5	Site for off-seam casting	12
Fig.6	Casting in truck/shovel cut	13
Fig.7	Casting in dragline cut	15
Fig.8	Highwall pushback by casting	16
Fig.9	Casting to lower level for removal by conveyor	17

INTRODUCTION

The Fording River Mine is one of the largest exporters of coal in Canada. It is located approximately 29 km northeast of Elkford, B.C. along the Fording river in the southern Canadian rockies (Fig.1). The active mining areas cover about 9600 acres. Over 5 million tonnes of clean coal is produced per year from surface operations. Nearly 50 million cubic metres of waste rock and rav coal is moved every year. Primarily a truck/shovel operation, the mine also utilizes a dragline with 40m bucket. It is a mountain top mining situation where the prestripping is extensive resulting in high strip ratio and delays in cash flow. In addition to this difficulty, the construction of haul roads is difficult and expensive due to large elevation difference. Steep seams cause additional problems of dilution resulting in poor recovery at the preparation plant.

Blast casting is a useful technique which can greatly help to ease the situation. CANMET and Fording Coal Limited (FCL) are studying this method and will commence field trials in the near future. This paper describes a preliminary study for this work as well as the site selection investigation for this purpose. In the selection procedure certain criteria like reduction in cost of overburden handling, improvement in pit recovery, availability of additional coal reserves etc. were utilized..

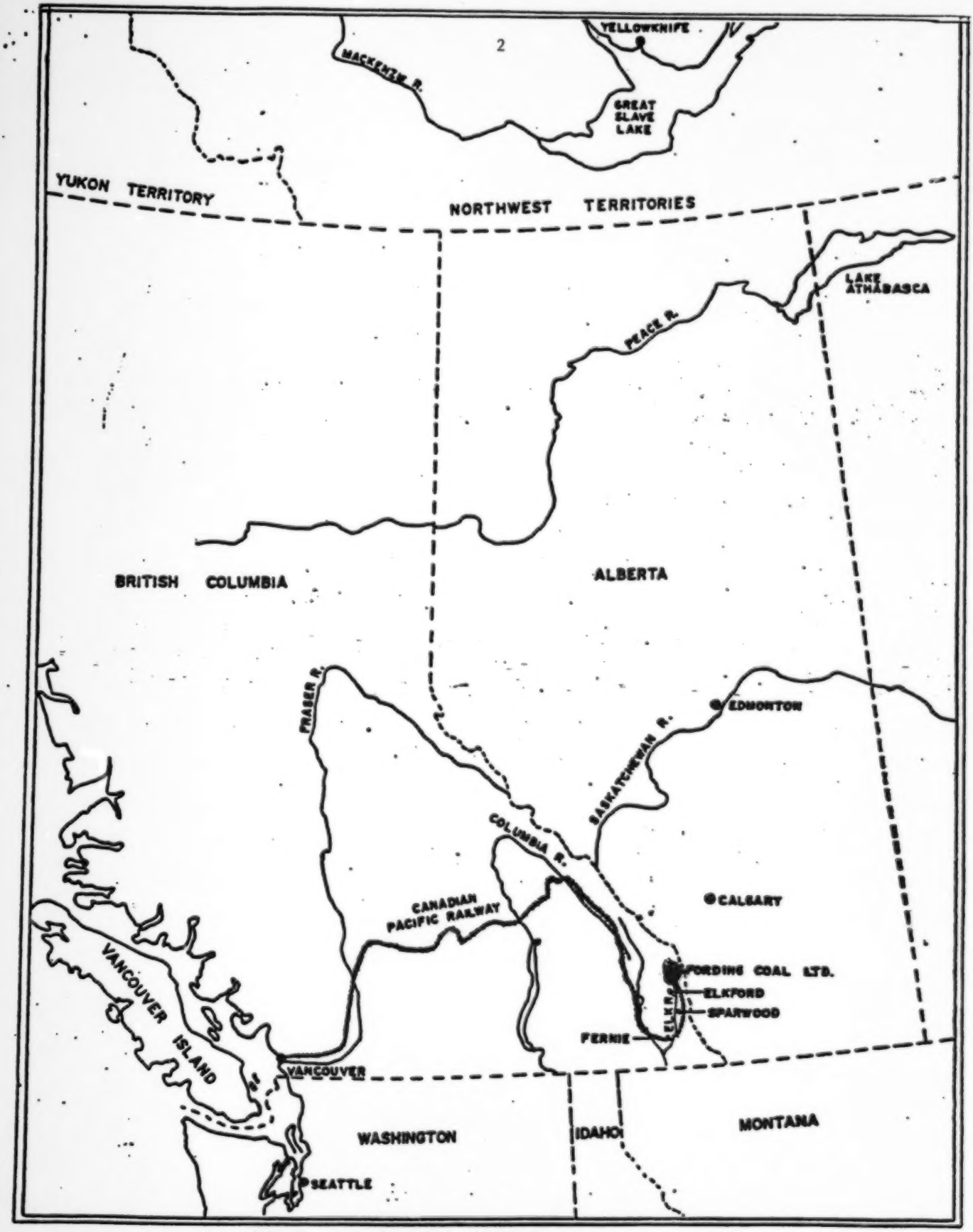

Fig.1 Location map of Fording River Operations

GEOLOGY

The coalfield is in an area of uplifting and tectonic action which created the Rocky Mountains. There are eleven major coal seams ranging in thickness between 1.5m to some 11m with an aggregate thickness of 60m. The formation thickness is 500m. Structurally, the mine area includes two synclines, one major normal fault and two major thrust faults. All of these are striking in a north to south direction (fig.2). The two synclines are located east and west of the Fording river. Due to faulting in the intervening anticline, the east side (Eagle Mountain) has been uplifted 300m compared to the west side (Greenhills). The two thrust faults on the Eagle mountain has caused repetition of seams. The complex geology has resulted in a diversity of coditions, e.g. steep seams, gently dipping seams, seams dipping into highwall, extensive overburden pre-stripping etc.

Blast casting has good potential for application in these different conditions to improve the overall productivity of the mine. It may also be possible to demonstrate the usefulness of this technique to plains coal deposits as well as other mountainous operations.

MINE LAYOUT AND CURRENT MINING PRACTICE

Practically all the seams are mined in this property, both at Eagle Mountain and at Greenhills. This enables the mine to produce different

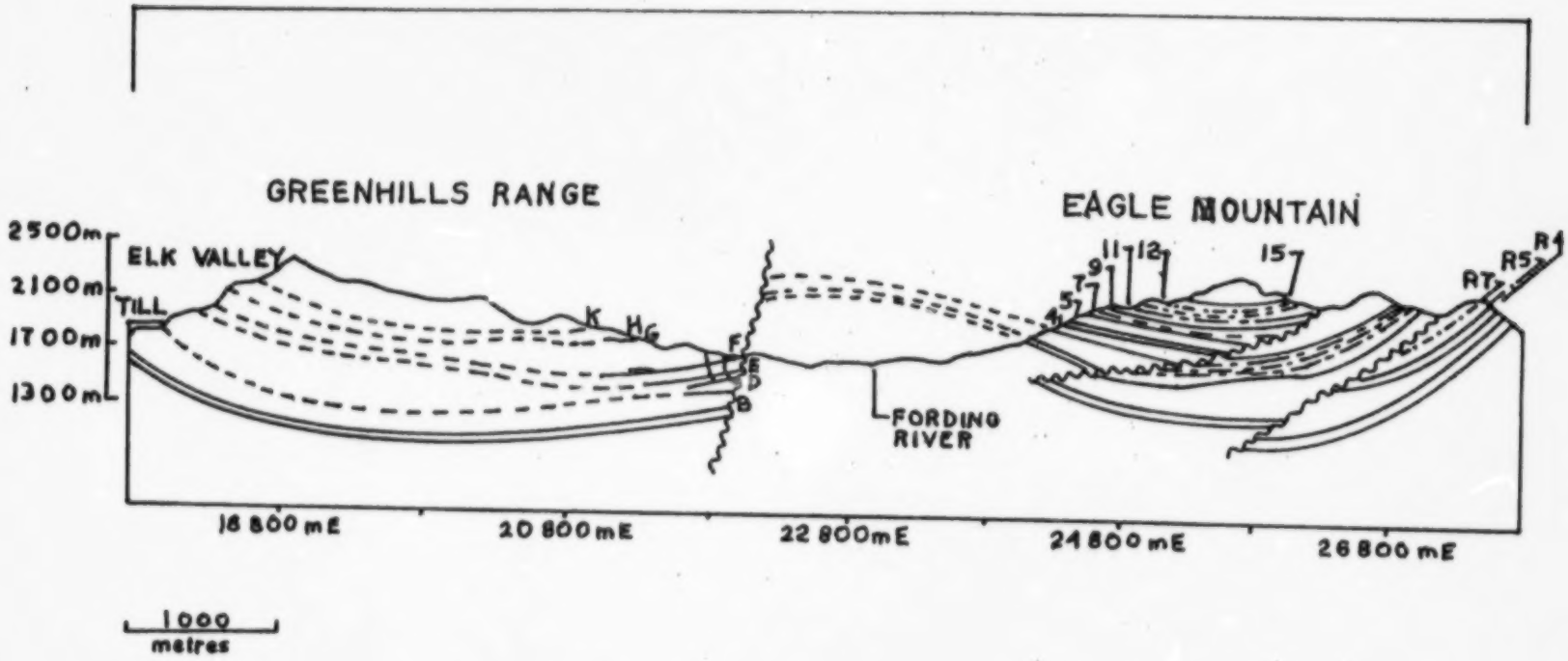

Fig.2 Typical structure cross section

products to meet the market demand. The mine layout is shown in Fig.3 in which the shaded areas indicate the operating pits.

On the Greenhills side, the pits are opened up by truck/shovel cuts followed with draglines at lover elevations. At Eagle mountain, contour mining is done. Here the pre-stripping is extensive and haul roads are very long. As mining progresses and the lover seams are mined, the overall strip ratio falls to within acceptable limits. All the overburden is drilled and blasted. A part of the blasted rock is handled by dragline but most of it is loaded by shovels into trucks and hauled for long distances to dumping points.

Several countries with similar mining conditions have adopted the technique of casting the overburden by blasting to improve the productivity of the mine by increasing overall overburden handling rate of the existing fleet. In Canadian surface mines, as the mining progresses the working conditions will become more severe and additional efforts would be required to keep the operations profitable. It is the opportune time to bring in any new technique or mining method which can enhance the mine performance.

PRELIMINARY STUDY

Different mine plans were studied and all the operating as well as the mined out pits were inspected. The field inspection consisted of:

(1) Evaluation of different sites throughout the property.

(2) Reviev of sites from mine plans.

(3) Identification of potential sites

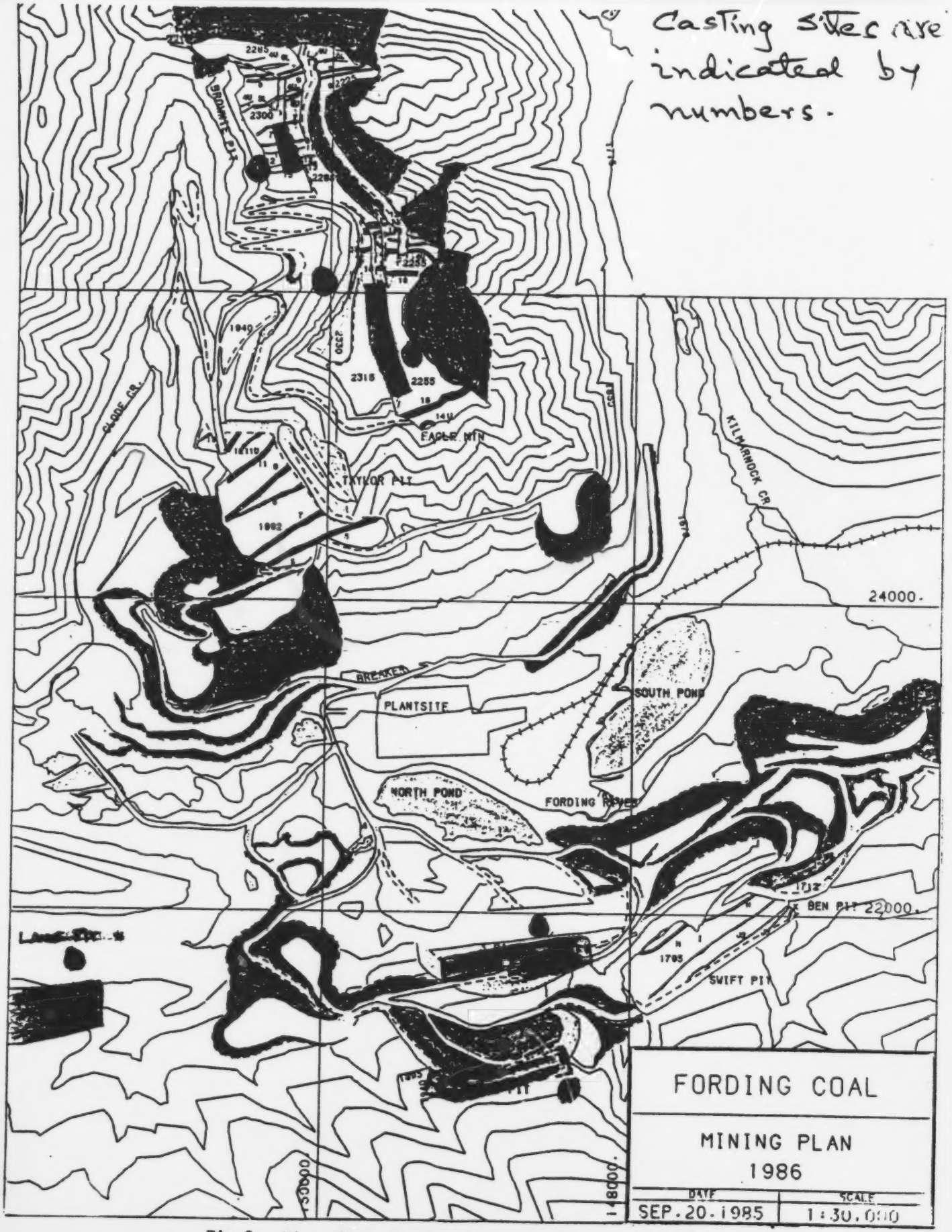

Fig.3 Mine plans showing pits and sites for casting

(4) Discussion and outlining of the program with the pit engineer, blasting engineer and pit foreman. The logistics, timing of blasts etc.were proposed.

(5) Economic viability and practical feasibility were evaluated for each site.

(6) Exploration and production drilling data from logged holes were collected and rough plans and sections were generated. These were then discussed with the geologists to define rock structure and prepare proper lithological sections.

Six areas were identified as potential sites for the application of blast casting. These sites are discussed later in the text.

SITE SELECTION

APPLICABILITY

The blast casting method can be applied to different mining situations; some examples of which are provided below:

-Flat or gently dipping coal seams where the overburden can be side casted into the previous cut or to the spoil piles (1). After the cast blast dozers level the blasted rock and prepare pad for the dragline to remove the leftover rock from the pit floor. This pad being at a lower level, the dragline can operate to an increased depth. Application of blast casting with a shovel/truck operation is much simpler as it has fever constraints.

-Mountain top mining where the burden can be casted into the adjacent valley or to a lower level pad for future removal. This essentially reduces the shovel/truck pre-stripping required to develop the operation and lessens the distance that a dozer, shovel or other spoil handling equipment has to move the prestrip spoil.

-In multi-seam mining for casting interburden and utilizing draglines for the extraction of lower seams. At the Colowyo mine in Craig, Colorado (2) the top three seams are extracted by shovel/truck operation while the interburden between the third and fourth seams is casted and a dragline is utilized for removing the leftover rock. All the five lower seams are then extracted by dragline operation.

While studying the mining conditions at Fording, all possible applications were kept in mind to decide upon the best sites.

SELECTION CRITERIA

The selection of sites for blast casting was made on the following criteria:

-Cost of overburden handling,

-Enhancement of coal reserve,

-Improvement of coal recovery,

-Reduction in rock hauling cost,

-Flexibility for the utilization of mining equipment

SITE EVALUATION

Using the above criteria various sites at Fording were investigated. The following six sites were determined to have the best potential applicability for blast casting:

Eagle Stage - 4

This is a mountain top situation requiring extensive pre-stripping overburden handling and long distance transport. Originally, it was planned to utilize contour mining on two limbs of the mountain advancing towards the core upto the stripping limits and then to extract coal from the core by underground mining. Later, the idea was modified to mountain top removal by truck/shovel. This, as mentioned earlier, requires extensive pre-stripping resulting in cash flow delays. This overburden can be casted into the adjoining valley which may not require rehandling in the near future. Even if required, it would be much cheaper compared to removing the waste from the top of the mountain (Fig.4).

Browny Pit

The seams are very steep in this pit. About 15m benches are maintained and the overburden is blasted with vertical drill holes. Though the seams are protected at drill hole intersections, the top and bottom of the seams

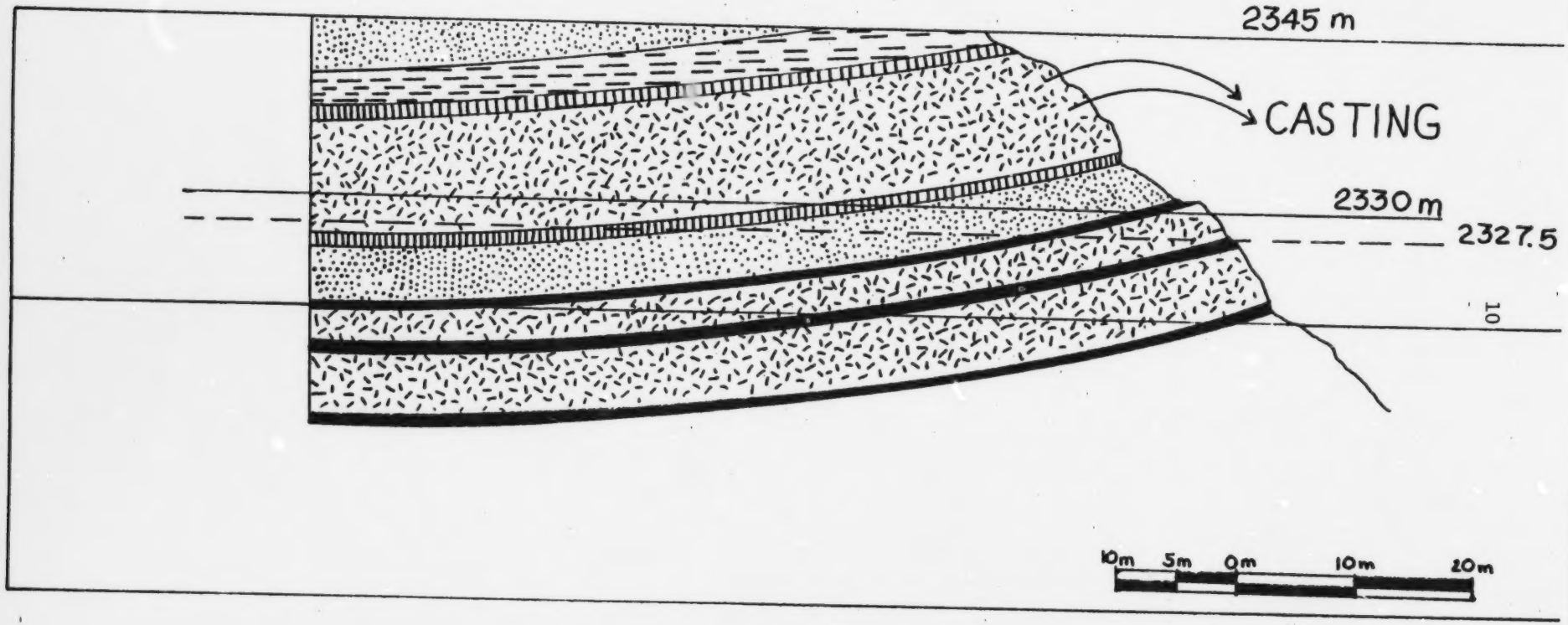

Fig.4 Site for mountain top casting

are affected by the lateral thrust of blasting. This is specially true in areas close to the drill holes and aggravates the problem of dilution.

It is planned to cast the burden off-seam with the use of inclined holes drilled at a very gentle angle to the bedding planes (see Fig.5). The interburden will then be pre-split to provide a vertical highwall for the casting of the remaining overburden. With this kind of blast casting the following improvements can be achieved:

-The coal seam is not disturbed by blasting.

-Low profile muck is provided so that loaders may be used for its removal,

-Coal extraction would be better as it will be done on a solid floor.

-Coal loading will be possible with loaders as with initial undercut the top coal would flow by gravity,and

-Toe rock will not be left in this case.

Lake Pit, Greenhills

This pit has been developed as a truck and shovel operation. The two coal seams that are mined, dip into the highwall. Due to the configuration of the seams and mountain topography, the strip ratio increases rapidly as mining progresses. The last stage of the Lake Pit where the strip ratio has reached the economic limit is illustrated in Fig.6. It is planned to conduct a casting trial by propelling the burden as well as the interburden directly into the truck/shovel cut and to utilize a dragline for handling the remaining rock.

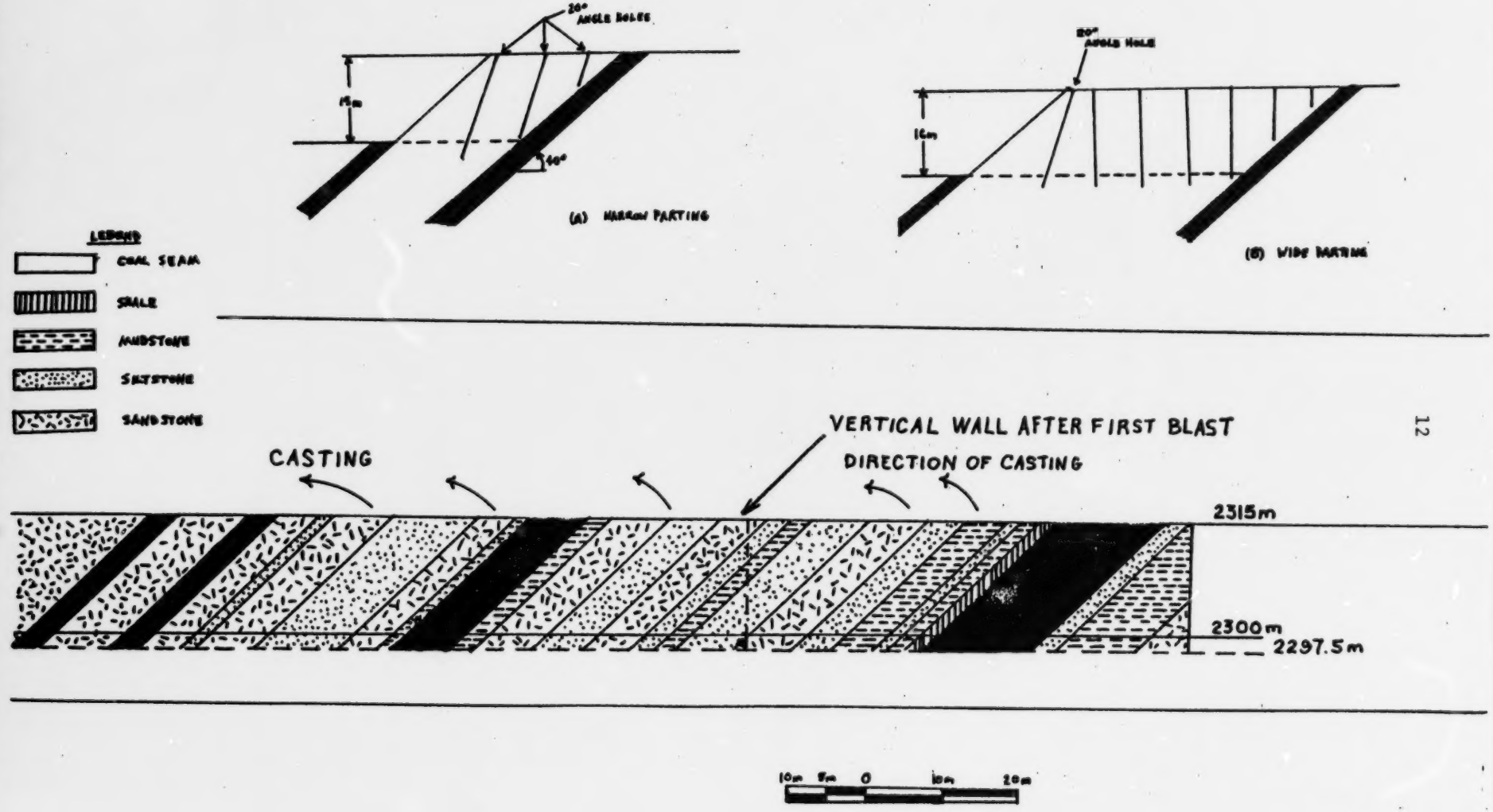

Fig.5 Site for off-seam casting

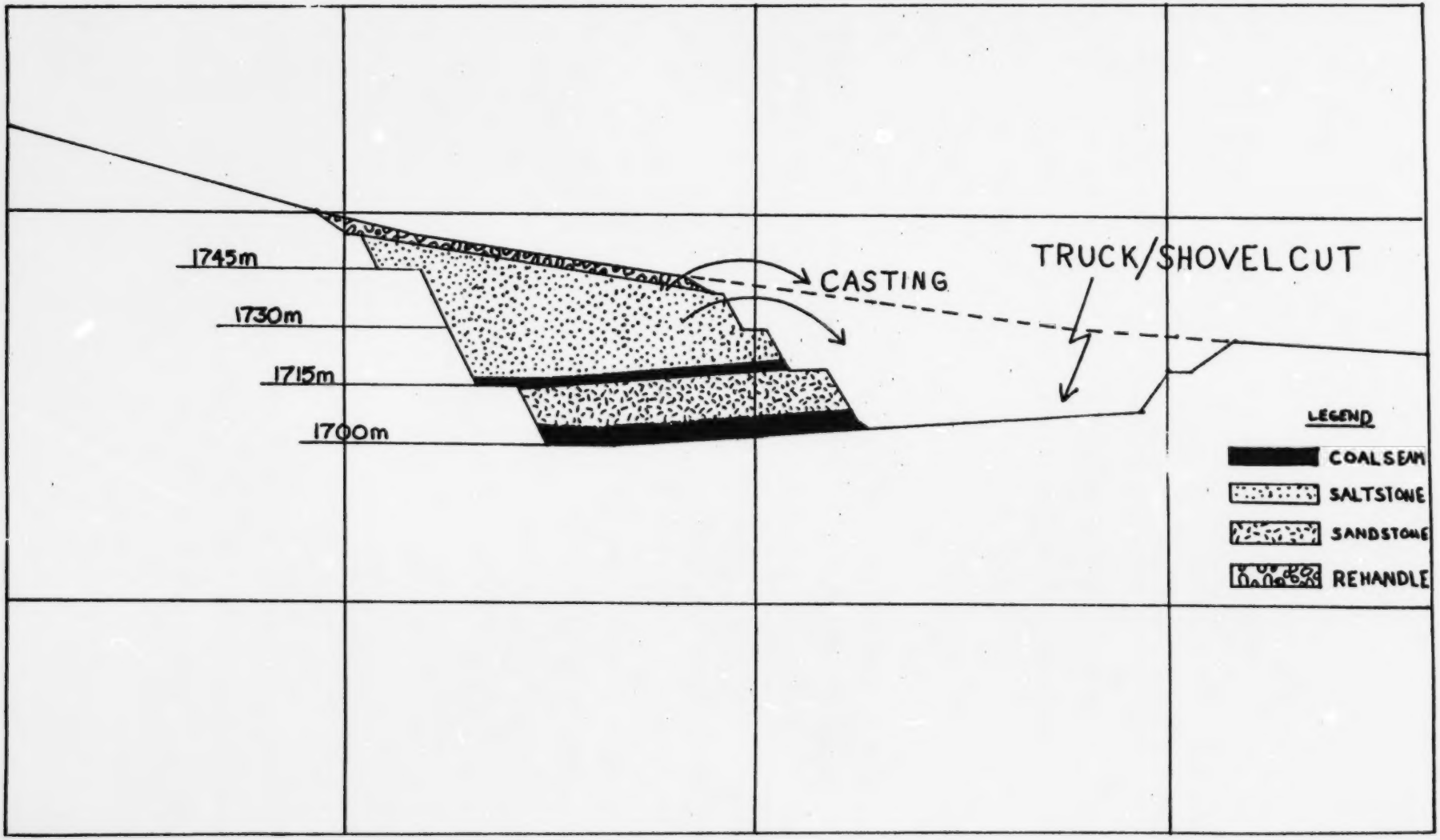

Fig.6 Casting in truck/shovel cut

No.3 Pit, Greenhills

The mining conditions in this Pit are similar to Lake Pit but No.3 pit was developed by dragline. Casting trial will be conducted to extend the life of the pit and provide additional coal reserves (see Fig.7).

I - Pit, Greenhills

This is an old pit that was mined out by truck/shovel operation. It is planned to cast the mountain top burden down to the bottom pit floor where dozers can be used to move the rock and expose the seams (Fig.8). This approach would provide additional coal reserves at a very moderate cost and has the following advantages:

-No electric power is required.

-Waste burden does not need hauling.

-Shovels will not be required since dozers can be used instead.

-Only mobile equipments like loaders, trucks, drills, powder trucks etc. will be required,and

-The existing coal haulage road would be used thereby saving cost.

Eagle Stage-IV extention

A cross section of this pit is shown in Fig.9. It has reached Stage-IV with an overburden thickness of 150 m which is the economic limit. The hauling distance from the pit to the spoil is about 2.2 km. It is planned

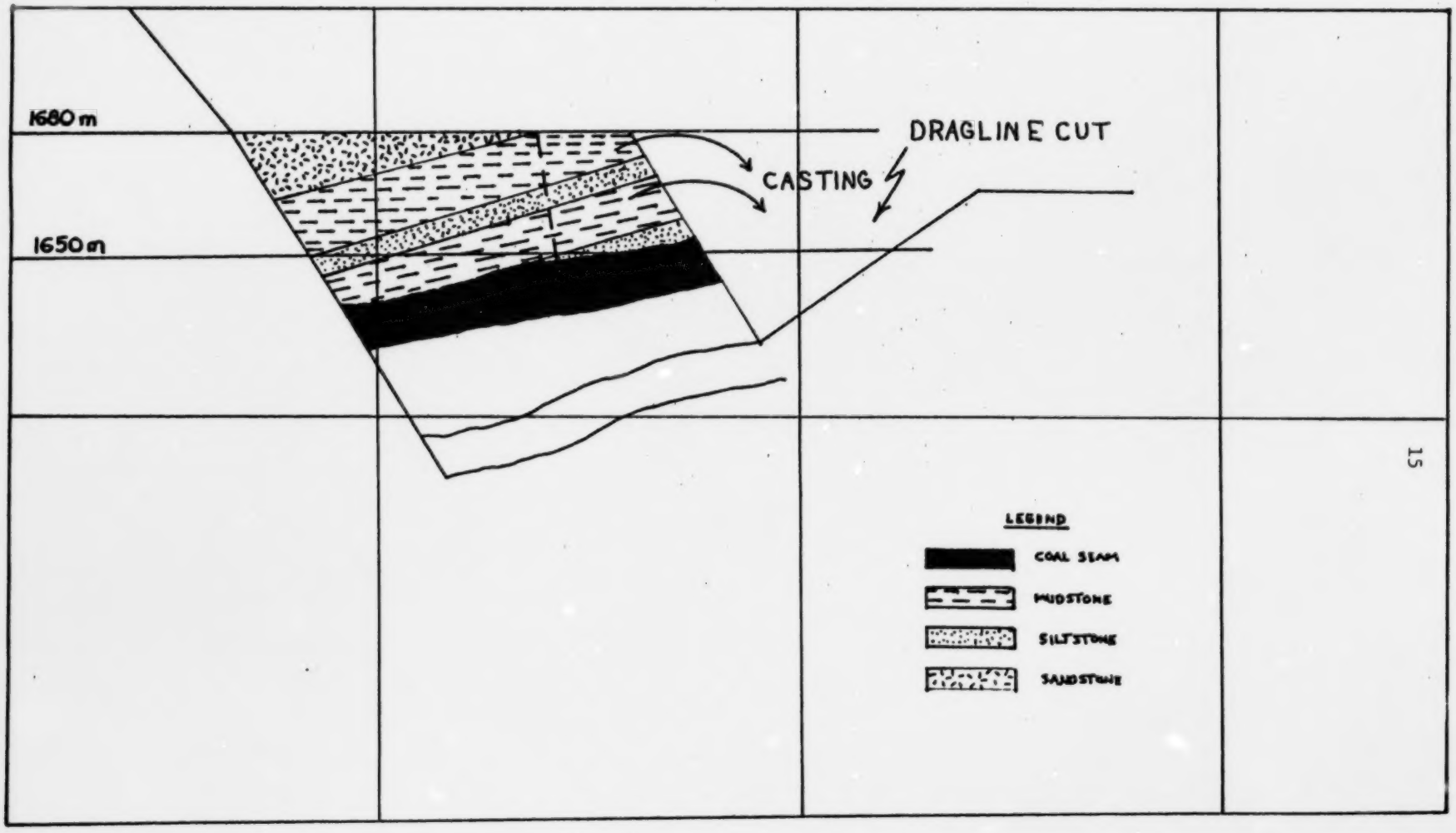

Fig.7 Casting in dragline cut

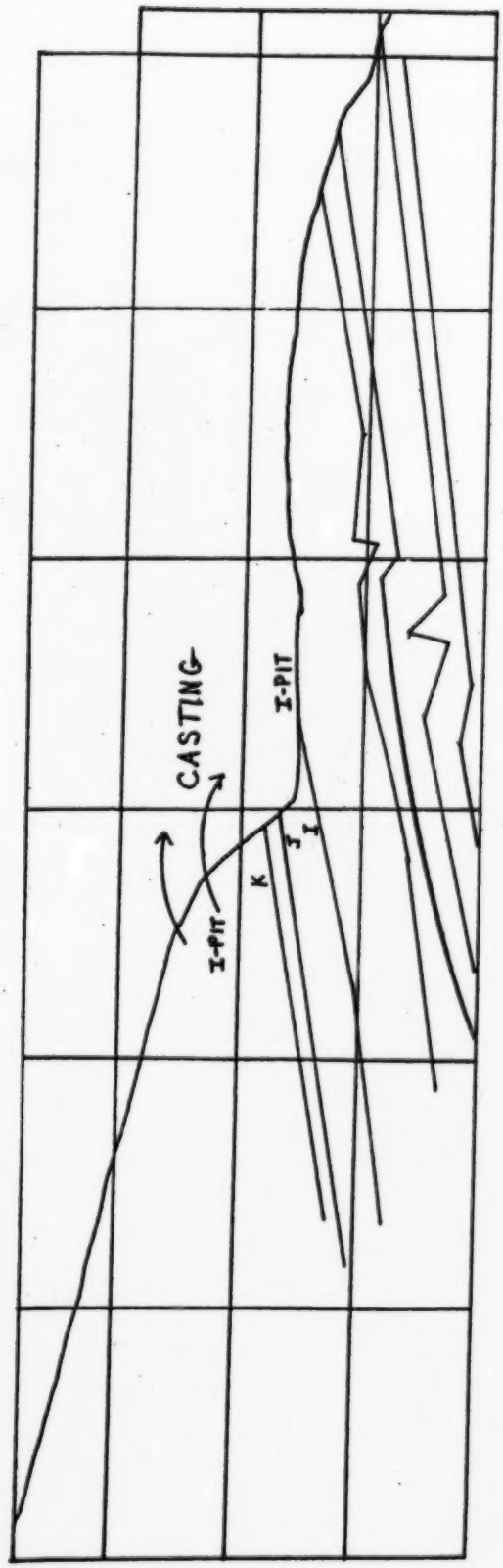

Fig.8 Highwall pushback by casting

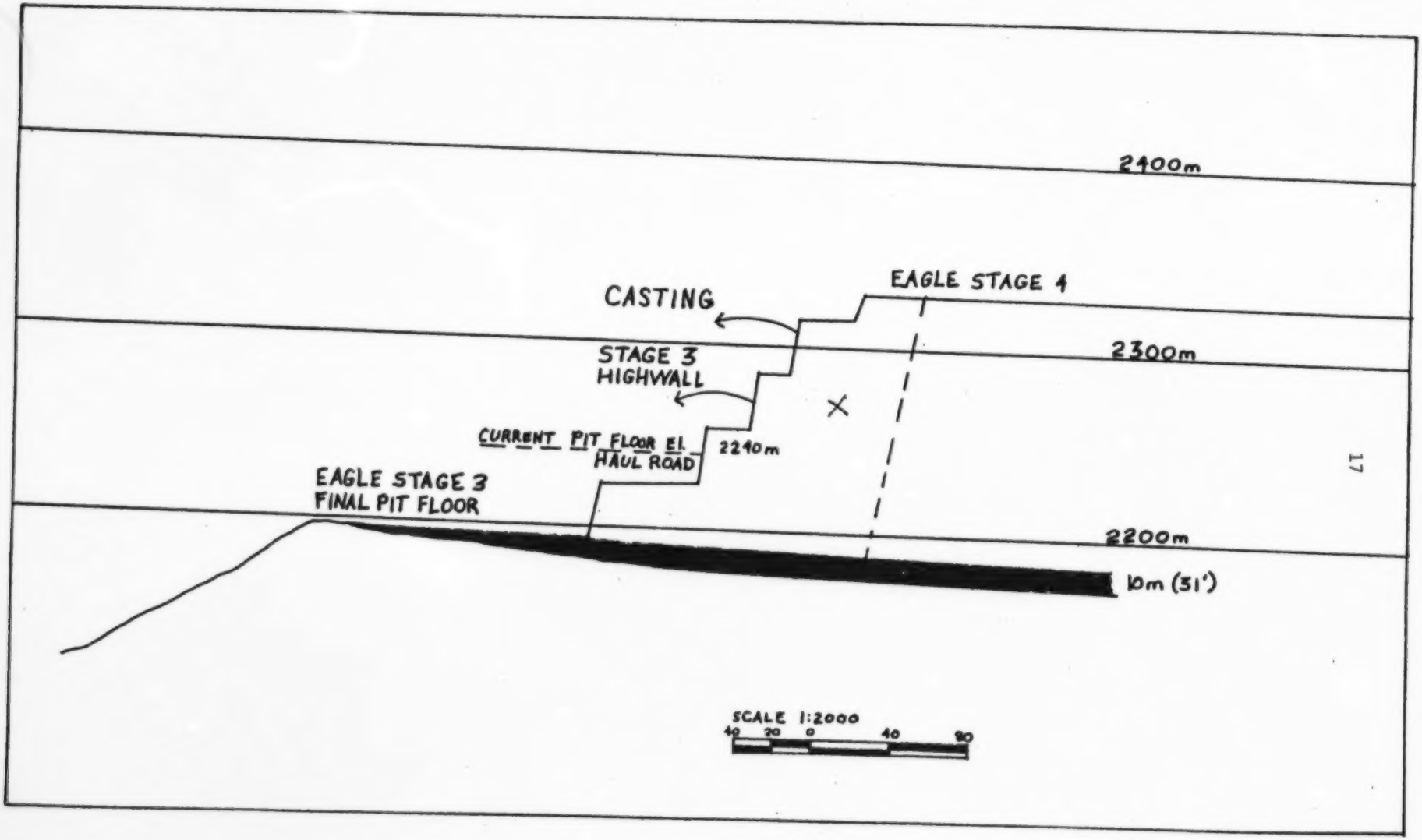

Fig.9 Casting to lower level for removal by conveyor

to cast the block 'X' to a lover bench for its subsequent haul by other means of transport, for example, conveyor.

CONCLUSIONS

Blast Casting has a good potential in Western Canada for enhancing mine productivity, improving coal recovery in the pit, providing more flexibility for the use of mining equipment, increasing the life of the pit etc. The different geological settings at Fording River Mine will provide ideal testing grounds for assessing the application of this technique. The information gathered during field trials will be very useful for other Canadian surface mines operations.

ACKNOWLEDGEMENT

The author would like to thank G. Clausen, of Fording Coal Ltd for providing information and the figures used in this report.

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